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**السكشن : 3**

**حل شييت 1 و 2 في الهندسة الميكانيكية**

# SHEET (1)

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1) $N = kg\frac{m}{s^2}$

$$F = ma$$
$$a = \frac{v}{t}\left(\frac{m}{s^2}\right) \quad , \quad v = \frac{x}{t}\left(\frac{m}{s}\right) \quad , \quad m \to kg$$
$$\therefore \quad F = Kg\ m/s^2$$

2) $Viscosity \to Pa.s$

$$\tau = \mu\frac{u}{h} \ \to \ \mu = \tau\frac{h}{u}$$
$$\because \quad \tau \to Pa \quad ,h \to m \quad ,u \to \frac{m}{s}$$
$$\therefore \quad \mu = Pa\,.\frac{m}{\frac{m}{s}} = Pa\,.\,s$$

$Kinetic\ Viscosity \to m^2/s$

$$\upsilon = \frac{\mu}{\rho}$$
$$\mu \to Pa.s \quad ,\rho \to \ \frac{kg}{m^3}$$
$$\upsilon = \frac{Pa.s}{\frac{kg}{m^3}} = \frac{\left(\frac{N}{m^2}\right)s}{\frac{kg}{m^3}} = \frac{kg.m.s.m}{kg,s.s} = \frac{m^2}{s}$$

3)

$$\rho_{water} = 1000\ kg/m^3$$
$$Specified\ Volume = \frac{1}{\rho} = \frac{1}{1000} = 0.001\ m^3/kg$$

4)

$$Specified\ weight\ (\gamma) of\ certain\ liquids\ \ 10\ N/m^3$$
$$\gamma \ = \rho g\ (\frac{N}{m^3})$$
$$\rho = \frac{\gamma}{g} \ = \frac{10 * 10^3}{9.81} = 1019.36\frac{kg}{m^3} \to Density$$
$$S = \frac{\rho_{liquid}}{\rho_{water}} \ = \frac{1019.36}{1000} - 1.019 \to specified\ gravity$$

5)

$mg = \rho v g \qquad mg = 8\,N$

$\gamma = \rho g = \dfrac{mg}{v} = \dfrac{8}{500 * 10^{-3} * 10^{3}(100)^{-3}} = 16\,kN/m^2$

$Volume = 500\,ml = 500 * 10^{-3} * 10^{3} * (100)^{-3}\,m^3$

$\therefore specified\ weight\ (\gamma) = 16\dfrac{kN}{m^3}$

$density\ (\rho) = \dfrac{\gamma}{g} = \dfrac{16000}{9.81} = 1630.98\dfrac{kg}{m^3}$

$Specified\ gravity = \dfrac{\rho_{liquid}}{\rho_{water}} = \dfrac{1630.98}{1000} = 1.63$

6)

$\Delta v = \dfrac{1}{100}\,v \quad B = \dfrac{1}{k} \Rightarrow k = \dfrac{1}{9.65 * 10^{-16}}$

$B = 9.85 * 10^{-10} \qquad k = 2.06 * 10^{9}$

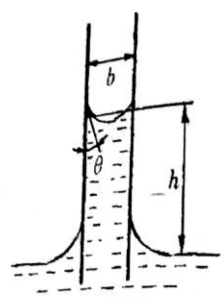
$\therefore\ \ k = \dfrac{\Delta P}{\frac{\Delta V}{V}} = V\dfrac{\Delta P}{\Delta V} = V\dfrac{\Delta P}{v}$

$\therefore\ \ K = \Delta P * 100$

$\Delta P = \dfrac{k}{100} = 2.06 * 10^{9} * 105 = 203.3\,atm$

$water\ need\ pressure\ reach\ to\ \mathbf{202.3}\ atm\ to\ shrink\ of\ \mathbf{1}\%$

7)




$Fore\ Plane$

$Tcos\ (\theta)[b + L * 2 = \rho g[hlb]$

$h = \dfrac{2Tcos\theta\ l}{\rho ghl} = \dfrac{2Tcos\ \theta}{\rho g}$

$T = 0.0728\,N/m$

8)

$S = 0.92 \qquad m\,u = 9 * 10^{-4}\dfrac{m^2}{s}$

$$S = \frac{\rho_{liquid}}{\rho_{water}} \rightarrow \quad \rho_{liquid} = S\,\rho_{water} \; = 0.92 * 1000 = 920\,\frac{kg}{m^3}$$
$$\upsilon = \frac{\mu}{\rho_{liquid}} \quad K \rightarrow \quad \mu = \upsilon\,\rho$$
$$\mu = 4 * 10^{-4} * 920 = 0.368\,Pa.s$$
$$equation\ of\ curve : \frac{u}{\upsilon} = \frac{3}{2}\frac{g}{\delta} - \frac{1}{2}\left(\frac{g}{\delta}\right)^3$$
$$u = \frac{3}{2}\frac{g}{\delta}\,\upsilon - \frac{1}{2}\frac{y^3}{\delta^3}\;\upsilon$$
$$\frac{du}{dy} \; = \frac{\frac{3}{2}\upsilon}{\delta} \; - \frac{3}{2}\frac{y^3}{\delta^3}\;\upsilon$$
$$\tau = \mu\frac{du}{dy} = 0.368\;\left[\frac{3}{2}\frac{\upsilon}{\delta} - \frac{3}{2}\frac{y^2}{\delta^3}\;\upsilon\right]$$
$$at\ y = 0 \quad ,\tau = 0.55\;\frac{\upsilon}{\delta}$$

أي تسير في اتجاه عكس اتجاه السرعه

9)

$$\delta = 900\,\frac{kg}{m^3} \qquad ,\upsilon = 30 * 10^{-6} = \frac{\mu}{\rho} \rightarrow \mu = 0.027\,Pa.s \;\;, \quad h = \frac{125 - 122}{2} \quad = 1.5 * 10^{-3} mm$$
$$\tau = \mu\frac{u^2}{h} == 0.027 * \frac{1}{1.5 * 10^{-3}} \;\; = 18\,\frac{N}{m}$$
$$\tau = \frac{F}{A} \quad \rightarrow \quad F = \tau A$$
$$= 18 * 200 * 122 * R * 10^{-9}\;\; A = 1.379\,A$$

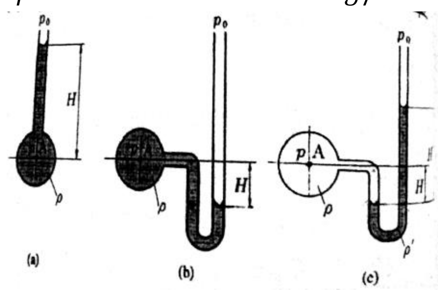
# SHEET (2)

1)

$$h = 6500\, m \quad , \qquad \delta_r \;\; for\; sea\; water\; = 1.03$$
$$P = \rho g h \; = 1.03 * 1000 * 9.81 * 65000 = 656.77\, Par$$

2)

$$S.G \;\; for\; sea\; water = 1.03$$
$$\rho = 1.03 * 1000 = 1030\; kg/m^3$$




a) Fig (a)

$$P = \rho g h = 1030 * 9.81 * H \;= 10104.3H \;+ P_0(Pa)$$

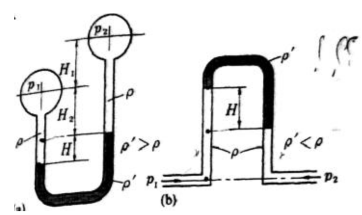
b) Fig(b)

$$PA + \rho g h = P_o$$
$$P_A = P_a - \rho g h \;= P_o - 10104.3H\; (Pa\;)$$

c) Fig (c )

$$P_A \;+ \rho_A g H_1 \;= P_0 + \rho_2 g H_2$$
$$P_A = P_0 + \;\rho_2\, g H_2 - \rho_A g H_2$$

3)



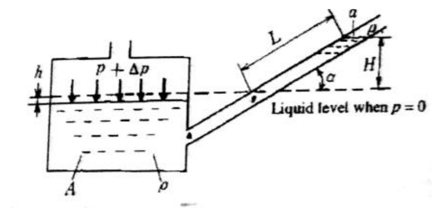

Fig(a)

$$P_a + \rho g H + \rho g H_2 \quad = P_2 + \rho'\, g H + \rho g H_2 + \rho\; g H_2$$
$$P_1 - P_2 = \rho' g H + \rho g[H_1 + H_2] - \rho g[H + H_2]$$
$$\therefore \;\; The\; pressure\; depends\; on\; the\; deifference\; of\; height$$

Fig(b)

$$P_1 - \rho g H_1 - \rho g H = P_2 - \rho g H_1 - \rho' g H$$
$$P_2 - P_2 = \rho g H_1 + \rho g H - \rho g H_1 - \rho' g H$$
$$P_1 - P_2 = \rho g H - \rho' g H$$

4)




$$v_1 = v_2$$
$$hA = la$$
$$h(100)a = la$$
$$L = 100\ h$$
$$H = L \sin 30$$
$$H = 100\ h \sin 30\ = 100 * 10^{-3} \sin 30 = 0.05\ m = 50\ mm$$

5)

$$F = \rho g h_c A \qquad h_c = 5 * \frac{3}{2} = 6.5$$
$$\therefore\ \ F = 1000 * 9.81 * 6.5 * 5 * 3 = 950475\ N$$
$$h_p = h_c + \frac{I_{xc}}{h.A} = \frac{6h^2}{12} = \frac{5 * 3^2}{12}\ = 3.75\ m$$
$$h_p = 6.5 + \frac{2.75}{6.5 * 5 * 3}\ \ = 6.538\ m$$

6)

$$F_1 = \rho g h_c\ A$$
$$F_1 = 1000 * 9.81 * 5 * 2 * 1 = 98100$$
$$h_{c_2} = 3 + 1 = 4\ m$$
$$P_2\ = \rho g h_{c2}\, A\ = 1000 * 9.81 * 4 * 2 * 1$$
$$F_2 = 78480\ N$$
$$h_{p1}\ = h_{c1}\ + \frac{I_{xc}}{h_{c1A}} \qquad , I_{xc} = \frac{1 * 2^2}{12}\ = \frac{1}{3}$$
$$h_p = 5.03\ m \qquad h_{p2}\ - 4.0416\ m$$
$$F_R = 98100 - 78480 = 19620\ N$$

7) Or (8)

$$H = \frac{h}{\sin 60} = 10\sqrt{3}$$
$$h_c = \frac{15}{2} = 7.5\ m$$
$$F = \rho g h_c\ .wH$$
$$= 100 * 9.81 * 7.5 * 10\sqrt{3} * w = 127435\ w$$

$$\frac{F}{w} = 127356\ N$$

$$h_p = h_c + \frac{I_{xc}}{h_c A} * \sin^2\theta$$

$$I_{xc} = \frac{w * \frac{h}{\sin 60}}{12} = \frac{10\sqrt{3}\ w}{12}$$

$$hp = 7.508\ m$$

9)

Assume the height = 4 m

$$h_c = 2 + 1 = 3\ m$$

$$A = \pi r^2 = \pi\ m^2$$

$$F = \rho g h_c\ A = 1000 * 9.81 * 3 * \pi$$

$$F = 92457.0\ N$$

$$h_p = h_c + \frac{I_{xc}}{h_c} \quad \to I_{xc} = \frac{\pi R^4}{4} = \frac{\pi}{4}$$

$$h_p = 3 + \frac{\pi}{4 * 3 * \pi} = 3.083\ m$$

The momentum of shaft

$$M = f\left(h_p - h_c\right) = 92457.07\ N * (\ 3.083 - 3) = 7701.67\frac{N}{m}$$